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# **National Certificate in Computer Applications Year 1**

## **Quantitative Methods (ACCS) Summer Examination 2002**

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Date : May, 2002

Duration : 2 hours

Examiner : Jonathan Brazil

### **Instructions to candidates :**

- **Answer five questions of your choice**
  - **Attempt each part of each question you answer**
  - **All questions carry equal marks**
  - **Write clearly**
  - **Read the questions carefully**
  - **Show all rough work**
  - **Calculators are allowed**
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### Question 1

- (a) Given the equation of a line  $7x - 2y = 3$ , draw the line (roughly) showing how you established the points which the line was drawn through.

( 3 marks )

- (b) Draw the following lines using the same axes for each

(i)  $-3x - y = 6$

(ii)  $2y - 6x = 25$

( 3 marks )

- (c) Use simultaneous equations to find the point where these lines intersect?

( 4 marks )

- (d) A rope is 24 inches long. Should the rope be set on fire it will burn at the rate of 1 inch every 45 seconds, assuming the rope is dry. If the rope is damp then it will burn at the rate of 1 inch every 60 seconds. If the rope is coated in fuel then it will burn at the rate of inch every 15 seconds. The scenario is as follows: 8 inches of the rope are dry, 8 inches are coated in fuel and 8 inches are damp. What is the average speed at which the entire rope will burn? Specify your answer in inches per second. The formulae at the back of the paper may assist you with your answer.

( 4 marks )

- (e) Which of the following lines are increasing? ( i.e. have a positive slope )

(i)  $3x - 14y = 12$

(ii)  $-5x - 2y = 0$

(iii)  $7x = 0y - 9$

( 6 marks )

## Question 2

(a) Perform the following matrix operations ( show all workings )

$$(i) \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} + \begin{pmatrix} 7 & 9 \\ 8 & 15 \end{pmatrix} =$$

$$(ii) \begin{pmatrix} 2 & -2 \\ -3 & 1 \end{pmatrix} - \begin{pmatrix} -9 & 4 \\ 0 & 1 \end{pmatrix} =$$

$$(iii) 5 \begin{pmatrix} 2 & 1 \\ 3 & -4 \end{pmatrix} + 2 \begin{pmatrix} 4 & -3 \\ 1 & -2 \end{pmatrix} =$$

$$(iv) \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 5 & -4 \\ -2 & 8 \end{pmatrix} =$$

( 8 marks )

(b) Find the inverse of  $\begin{pmatrix} -4 & 3 \\ 2 & 4 \end{pmatrix}$

( 6 marks )

(c) Hence solve the simultaneous equations below using matrices

$$3y = 4x + 9$$

$$4y = -2x - 15$$

( 6 marks )

## Question 3

The following table gives the weekly earnings of all the employees in an example SME (Small to Medium sized Enterprise).

Weekly Earnings (€)	Number of Employees
301 to 400	12
401 to 500	16
501 to 600	30
601 to 700	24
701 to 800	12
801 to 900	6

Table 3.1 weekly earnings versus number of employees

(a) How many employees are there in this company.

( 1 marks )

(b) Present the data in a cumulative frequency distribution table.

( 3 marks )

(c) Draw the histogram and ogive of the data.

( 6 marks )

(d) Estimate the mean and the standard deviation.

( 6 marks )

(e) Estimate the inter-quartile range.

( 4 marks )

#### Question 4

- (a) Explain **in your own words** the term effective rate of interest. ( 2 marks )
- (b) Explain **in your own words** the declining balance method of depreciation. ( 2 marks )
- (c) Richard is planning on buying a house as a long term investment. He already has €40,000 which he can use as a deposit. The cost of the house will be €150,000. Assuming that he gets a mortgage for the remainder of the cost of the house from his bank at a rate of 5.4% per annum, compounded monthly. His two options for the duration of the mortgage are:
- (i) 20 years
  - (ii) 25 years

A financial eagle has told Richard that his house will be worth €250,000 in 20 years and €280,000 in 25 years. Given that Richard plans to sell the house when the mortgage is repaid, which option will give him the greatest profit margin?

( 8 marks )

- (d) Siân wishes to purchase a new car in 15 months time. The car will cost her €25,395. She currently has €18,500 in savings that she can put away for 15 months into a special savings account with a healthy 3.6% interest, compounded monthly. If she takes this option will her accumulated savings be enough to buy her the car in 15 months time? ( 4 marks )
- (e) A car is purchased for a company at a cost of €25,000. The car is expected to have a life of 5 years. Assuming that the company employs the 150% declining balance method of depreciation:
- (i) How much will the car depreciate by in the first year?
  - (ii) How much will the car be worth at the end of the 3<sup>rd</sup> year?

( 4 marks )

### Question 5

The following table is a presentation of the “No” votes gathered from 20 different locations in a fictitious referendum. Examine the data and answer the questions which follow:

120	60	60	40	70
75	75	75	84	80
50	42	75	59	90
80	40	40	120	90

Table 5.1 “No” vote counts

- (a) Present this data in a frequency distribution table. ( 2 marks )
- (b) Calculate the mean and median of this data. ( 6 marks )
- (c) Calculate the inter-quartile range and the standard deviation. ( 6 marks )
- (d) Give a brief description **in your own words** of multistage sampling. ( 2 marks )
- (e) Assume that 9 % of the population is unemployed and 51 % of the population is male. Given this data, construct a stratified sampling plan for a sample of 2400 people. ( 4 marks )

### Question 6

- (a) Explain the primary reason why Boolean logic became the accepted foundation for most programming languages and computer systems. Your answer should be to the order of three or four lines and give a detailed description of why. ( 3 marks )

- (b) Provide the truth tables for the logical AND and the logical IMPLIES operations. ( 4 marks )

- (c) Use truth tables to solve the following logical sentence:

$$p \vee q \wedge \neg q$$

( 5 marks )

- (d) The following truth table presents the detonation criteria for a missile. The missile has three sensors (A, B, C) and depending on the combination of these sensors being active or inactive, the missile will explode. Examine the table and produce a logical sentence for F (the detonation sequence).

A	B	C	F
0	0	1	1
0	0	0	1
1	1	1	1
1	1	0	1

( 4 marks )

- (e) Use truth tables to prove the correctness of this logical statement:

$$\neg p \vee q = p \rightarrow q$$

( 4 marks )

### Question 7

An independent research team who conduct bizarre surveys have noticed that from the people interviewed in 6 different locations, that the average number of dog purchases recorded per year seems to be in some way related to the average amount of time spent reading Gary Larson comics each week! Could there really be a link? You are presented below with the results obtained from the research, examine them and answer the questions that follow:

# of dog purchases	450	560	300	500	700	100
Time spent reading Gary Larson comics (minutes)	120	150	70	90	160	60

Table 7.1 average number of dog purchases per year and average time spent reading comics

- (a) Calculate and draw the regression line that relates the time spent reading the comics and the number of dog purchases per year. ( 6 marks )
- (b) Calculate the correlation coefficient. ( 4 marks )
- (c) Estimate the expected number of dog purchases per year when the average time spent reading Gary Larson comics is:
- (i) 140
  - (ii) 200

Which of these would you regard to be more accurate and why?

( 6 marks )

- (d) Imagine the average time spent reading the comics went up by 5%, would you expect the average number of dog purchases to increase by 5% also? Why? ( 4 marks )

## Linear Regression

1. Linear regression parameters **a** and **b**

$$S_{xy} = \frac{\sum xy}{n} - (\bar{x})(\bar{y})$$

$$S_{xx} = \frac{\sum x^2}{n} - (\bar{x})^2$$

$$S_{yy} = \frac{\sum y^2}{n} - (\bar{y})^2$$

$$b = \frac{S_{xy}}{S_{xx}} \quad a = \bar{y} - b\bar{x}$$

2. Correlation coefficient

$$r^2 = \frac{S_{xy}^2}{S_{xx}S_{yy}}$$

## Financial Mathematics

1. Future value of annuity

$$FV = \frac{R(1+r)\left((1+r)^t - 1\right)}{r}$$

2. Present value of annuity

$$PV = \frac{R\left(1 - \frac{1}{(1+r)^t}\right)}{r}$$

## Statistics

1. Quartiles

$$Q = L + \frac{r}{f} c$$

2. Arithmetic mean

$$\bar{x} = \frac{\sum f(x)}{\sum f}$$

3. Standard deviation

$$s = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$$

## Speed

Speed \* Time = Distance